Watershed Dairy Environmental Cooperative - Part 1

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Project Sponsor:	*Kansas State University*
Project Manager:	*Joseph P. Harner* *Extension Biological & Ag Engineering* *237 Seaton Hall* *Manhattan, KS 66505*
Phone Number:	*785-532-5813*
Fax Number:	*785-532-6944*

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Project Name: Watershed Dairy Environmental Cooperative - Part 1

Sponsor:

Contact Name: Joseph P. Harner
Phone Number: 785-532-2930
FAX Number: 785-532-6944
E-mail: jharner@bae.ksu.edu

Summary

The Watershed Dairy Environmental Cooperative - Part 1 was able to provide assistance to 13 small dairy producers managing 1,680 lactating cows. These producers voluntary worked with the program in addressing environmental issues. Prior to participating in the program, the dairy producers were not able to store manure during extended wet weather or extremely cold weather when ground was frozen. Frequently, manure would have been applied to wet ground. The program enabled them to increase the storage capacity and change management practices to haul prior to tillage operations. This reduced soil compaction, nutrient losses and prevented runoff and nutrient losses during wet weather. Generally, the dairies had more time to manage the dairy cows since cows number tended to increase once environmental issues were addressed. The dairies were located in four different watersheds. Most of the dairies were in the Nemaha watershed that is adjacent to the Black Vermillion watershed where work had begun previously. Dairies in the Nemaha watershed heard of the program through contact with producers in the other watershed. Manure sampling was begun on nine dairies in northeast, Kansas.

Nine concrete storage basins were sampled on Kansas dairies and analyzed for nutrient content of sand laden dairy manure. The manure average 75 percent moisture content during the three sampling periods. The average total nitrogen, phosphate and potash was 9.7, 4.6 and 7.4 lbs/ton, respectively. The data collected from the basins suggest if the scraped manure from a dairy was applied at an agronomic rate of 15 tons or less per acre, there should be minimal accumulation of nutrients, in particular phosphorus. The manure value was $3 to $4 per ton depending on whether commercial sources of phosphorus would normally be applied to the cropland.

Preliminary soil sampling indicates sixty four percent of the fields (7 of 11) in northeast Kansas would be able to apply dairy manure on a nitrogen basis if the current Kansas swine manure application regulations were adopted. Due to high phosphorus levels in some fields, 2 of the 11 fields in northeast Kansas could not have any manure applied to them. Two other fields in northeast Kansas would have to limit manure application rates to the crop phosphorus usage. The data showed minimal accumulation of nitrogen and potassium in the soil profile.

Introduction

The initial goal of the Black Vermillion watershed (BVW) project started prior to the Watershed Dairy Environmental Cooperative - Part 1 (DEC-Part 1) project, was to bring the equivalent of a 1,000 cow dairy in compliance. Year one of the (BVW) project resulted dairies managing 670 cows within the watershed participating in the program. Preliminary evaluation of the watershed indicated 37 dairies were located within the 216 square mile watershed. These dairies ranged in herd size from 30 to 150 cows. There are approximately 550 dairies within Kansas. Most of these dairies are in similar in size to those found in the Black Vermillion watershed. Currently, about 30 dairies in the southwest part of the state manage approximately 50 percent of the 100,000 dairies cows housed in Kansas. The remaining dairies are smaller and scattered through out the state in various watersheds. After the Black Vermillion project was established, dairies from other watersheds inquired about a similar opportunity in their watershed. This resulted in the development of the Dairy Environmental Cooperative (DEC - Part 1).

A fifty cow dairy annually produces approximately 1,000 tons of manure, 10,500 lbs of nitrogen, 5,800 lbs of phosphorus and 8,300 lbs of potassium. Many of the dairies had small lagoons for complying with regulations to control milk parlor discharges. However, manure deposited on open lots or in loafing areas was generally uncontrolled during rainfall events. A portion of these nutrients left the dairies in runoff during rainfall events. Sediment entered surface water from uncontrolled flow of earthen loafing areas. Current facilities often did not provide adequate housing for the existing herd much less any future expansion. Therefore, future herd size was considered in addressing the environmental issues.

Project Mission and Goals

(Note: the goals and objectives of the DEC-Part 1 were identical to the Black Vermillion watershed goals. This report covers accomplishments in Part 1 of an original three part study)

The dairy environmental cooperative mission was to control manure and effluent nutrients leaving a farmstead and to effectively manage controlled nutrients with cropping practices.

Objectives

A. Develop and install demonstration systems for storage of dairy manure and effluent leading to reduced nutrient, fecal coliform and sediment runoff.

B. Develop and deliver educational programs for dairy farmers to assist them in implementing the best management practices for on-farm utilization of stored nutrients in lagoons or solid storage basins.

C. Develop local dairy cooperatives to assist dairy farmers in design of waste management systems and understanding the management of the systems.

Background of Dairies

Many of the dairies in Kansas were certified under the Kansas regulations that were effective from 1976 to 1996. These dairies do not exceed the 300 animal units (210 milk cows) in confinement for mandatory registration with current guidelines. However, control of the dairy milk parlor water results in most dairies having to address regulatory issues irrespective of size due to the daily discharge. In addition, many dairies were considered a potential pollution problem due to their inability to handle manure, in particular scraped manure from loafing areas and concrete lots, during wet weather. Manure was often applied to wet or frozen ground in an effort to minimize potential animal health problems or because of a lack of adequate storage facilities.

Another change during the past decade was a switch from organic bedding such as straw to inorganic bedding such as sand. Sand bedding improves health and milk quality by reducing mastitis and somatic cell counts, respectively. However, moisture from the manure is not retained or absorbed in the sand when compared to "biomass" types of freestall bedding. Therefore, the consistency of sand bedded manure is similar to a slurry when wet and cannot be stacked on concrete areas like manure containing straw, paper or wood shavings. Areas designed for handling stacked manure did not work when the dairy producers switched to sand. Sand bedding decreases the life of equipment due to abrasion during handling but improvements in herd health offset this disadvantage.

One-on-one meetings with the dairies found they were generally more concerned with the storage, handling and runoff of the solid portion of manure. Environmental regulations tend to focus on controlling the runoff from the manure stack and confinement areas and milk parlor wash water. KSU/CES began working with several Nemaha County dairy producers in 1993 to develop waste management plans to meet environmental regulations and structures to store sand laden manure.

Procedures

A system's approach including expansion, potential new facilities, and storage and management of the manure scraped from freestalls was considered when working with the dairies. All of the dairies increased their animal units or cow numbers during the permitting process. The average increase in size was 20 percent. The waste management systems were designed to provide 120 days for the proposed cow numbers even though the state regulations required 60 days storage. The increased volume allowed the dairies more time to manage their cows, 3 to 4 concentrated periods per year to haul manure, and the opportunity to expand further without having to change their manure handling structures.

Previous experience with the dairymen, who installed structures, indicated there was an educational opportunity to help producers understand how to manage the manure handling system and obtain maximum benefit from the nutrients. The manure management phase of the dairy was previously not considered as part of the system. In the watershed, there was open cropland during the fall, spring and

summer or about every 120 days. This enabled the dairies to empty basins prior to spring rains, after wheat harvest and prior to ground freezing during the winter. Also, the basins could be emptied immediately prior to tillage operations to minimize nitrogen losses to the atmosphere.

Scheduled Task and Accomplishments

Objective A: Develop and install demonstration systems for storage of dairy manure and effluent leading to reduced nutrient, fecal coliform and sediment in runoff.

Task 1. Contact dairies within the watersheds

Dairies within the different watersheds heard of the DEC program and contacted their local county extension agents. Dairies were provided assisted through the State Conservation Commission and DEC programs based on money available and time frame.

Task 2. Follow-up contact with interested dairies

Dairies expressing interest in the program received a follow-up visit at their farmstead. The program was reviewed. The producers had a choice between working with Kansas State University, Natural Resource Conservation Service, or private consultant.

Task 3. Obtain data necessary to complete plans

Information gathered from each farm include soil maps, topographical maps, cropping practices, land availability, future grow expectations, and other as needed for the permit. KDHE area technicians worked with the producer to ensure the application was completed. Sites were surveyed as necessary and KDHE technicians were consulted on options available to the producers. Not all of the producers were required to construct total containment systems. Some were able to use vegetative systems to control runoff from the lots. Most of the producers were required to control the milk parlor wash water.

Task 4. Develop control plans for dairy

Based on the information obtained, individual plans were developed for each farm. Figure 1 shows the basic layout of the systems developed based on areas where there was a potential for nutrients to leave the dairy.

Task 5. Review plans and cost with dairy

A follow-up visit with each dairy was conducted. The plans were reviewed with the producer along with estimated cost. Previous work with dairies indicated a dairy could expect to pay between 300 to 400 dollars per cow to meet existing environmental regulations.

Task 6. Revise plans as needed

KDHE field technicians were also contacted in regards to a preliminary review of the plans. After pre-approval by KDHE and the dairy producer, the final plan was developed and submitted to KDHE.

Task 7. Submit plans to KDHE for review

Producers approved the plans prior to their submittal to KDHE for approval. KDHE worked with producers to obtain any additional data needed for the permit.

Task 8. Begin construction per KDHE approval

Construction begin on the project once approval was obtained by KDHE.

Task 9. Construction of projects

Dairy producers had the option of providing labor to complete part or all of the work related to their plans. Some producers choose to complete the concrete work along with assistance from neighbors while others choose to work along side a contractor. Only one dairy opted to complete any of the preliminary earth work. All holding ponds or lagoons were completed by a contractor. Generally, the dairies felt it most important to control the solid manure or manure scraped from the loafing areas. Phase 1 typically was constructing the concrete solids storage basin with the runoff control structures being completed at a later date.

Task 10. Obtain final approval of KDHE

KDHE field technicians were advised of completed projects and then completed their final inspection prior to issue permits.

Task 11. Obtain cost data of the system

Dairy producers submitted copies of bills and expenses to KSU prior to receiving cost share payment. Table 3 shows cost data for the dairies.

Task 12. Develop total system material

Objective B: Develop and deliver educational programs to dairy farmers to assist them in implementing best management practices for on-farm utilization of stored nutrients in lagoons or solids storage basins.

Task 1. Review cropping practices

Minimal information was obtained regarding this task since the most common cropping practice was the production of corn silage. The corn silage was used in the total mixed feed ration.

Task 2. Obtain nutrient and soil samples

Seven dairies in northeast Kansas cooperated with the investigators by allowing them to soil sample a total of 12 fields that received dairy manure on a frequent basis. The results are reported in a latter section.

Task 3. Develop nutrient management plan

The concrete solids storage basin and lagoons were sampled on nine dairies in northeast, Kansas. The results are reported in a latter section.

Task 4. Implement nutrient management plan

The results from sampling in Task 3 were returned to the dairies along with recommendations in regards to application rates based tons or gallons per acre for their crops.

Task 5. Resample manure and effluent

Samples were taken four times during the year to evaluate the nutrient variability in the concrete basins based on time of year. The results are reported along with the results from Objective B, Task 3.

Task 6. Develop educational information

Educational information on nutrient sampling was presented at KSU Dairy Days.

Task 7. Conduct educational programs

Results were summarized and presented at various meetings including a manure nutrient management workshop and KSU Dairy Days.

Task 8. Develop nutrient management records

Visit with the cooperators indicated they maintained little or no records in regards to manure application rates, time of year, etc. There was general consensus that the current paper forms should be replaced by computer work sheet for record management.

Objective C: Develop local dairy environmental cooperatives to assist dairy farmers to design and complete waste management systems and understand the management of the system.

Task 1. Form a local advisory committee

A local advisory committee was not utilized when the DEC program expanded beyond the Black Vermillion watershed. Dairy producers within the watershed served as an advisory to the investigators by providing input on the designs, shared new ideas for improvements, and informed others of the project.

Task 2. Organize 2 to 4 exchange meetings/year

Environmental issues were discussed at various public meetings through out the year. Dairy producers often attend the KSU Dairy Day and DHIA annual meetings. In additional, a meeting was conducted on nutrient management for the producers participating in the program.

Task 3. Link cooperators during planning and construction

Cooperators were provided the opportunity to complete the project using a contractor or labor on the farm. Most felt it was more economical to use a general contractor. About 20 percent completed a portion of the work as one contractor would allow dairies to subtract labor provided by the dairy from the final project cost.

Task 4. Utilize local advisory committee

Utilized local producers to share ideas with one another. Once the first demonstrations were installed, they allowed other producers to visit their projects and discussed the benefits of controlling nutrients with them. The producers also assisted with local tours.

Task 5. Develop information related to purpose of the project

This was not necessary after the initiation of the Black Vermillion project due to the local network between dairy producers and the overall demand for participation in the DEC program.

Task 6. Obtain input for improving the permitting process

No action was taken during this phase of the project.

Task 7. Utilize local committee for public relations

Utilizing the producers as the local committee, resulted in them informing others of the cost share program. The county extension agents also informed producers within other watersheds of their county of the project. Each year, the demand for cost share dollars exceeded those available. The agents also worked with the local Non Point Source programs through Natural Resource Conservation Service. After the first year, the DEC and NPS program cooperated on many projects to extend the benefits to the dairy industry.

Task 8. Develop recommendations for permitting process

No action on this task.

Results

Table 1 shows the impact of the DEC- part 1 had on the Black Vermillion watershed. Three additional dairies received cost share dollars through DEC-part 1. These dairies average 90 cows per herd. Table 2 shows the practices installed on each of the dairies participating in DEC-part 1. Five of the 13 dairies had previously constructed a lagoon to contain the milk parlor wash water. Ten of the 13 dairies had less than 7 days storage for the scraped/solid manure. The other three dairies expanded their storage capacity due to expansion. These dairies wanted additional storage capacity mainly to allow them to better manage the manure nutrients with their cropping practices and had experienced the benefits of longer term storage. The solids storage basins were sized to provide 90 to 120 days storage. The objective was to provide storage and land apply manure immediately prior to a tillage operation. This reduced the days (with no storage, only 1 to 2 hours per day may have been needed) required to land apply manure from more than 50 days to less than 10 days per year. The producers were able to schedule when manure was being applied and in some cases shared equipment and labor to empty a structure in a timely manner.

Table 3 provides an indication of the nutrient loads being generated by the cooperating dairies. In DEC-part 1, these dairies were milking an estimated 1,680 cows that generated 3,535, 884 and 212 pounds per day of BOD, nitrogen and phosphate. Table 4 shows the cost shared dollars allocated to each dairy and estimated total cost of the projects. The initial objective was to provide approximately $200 per cow of cost share dollars based on an estimated cost of 300 dollars per cow. Dairies installing complete systems (lagoons and solid storage basins) spent an average of $320 per cow in 2000. Dairies shown receiving less than $4,000 reflect the cooperation with other available cost share programs. The average dollars allocated per dairy was $15,071 or $77 per cow.

The project success is a result of the cooperation between many agencies. These included the following:

Nemaha/Marshall County Dairy Cooperators
Nemaha/Marshall Cooperative Extension Service
Nemaha/Marshall County Natural Resource Conservation Service

Kansas Department of Health and Environment - Northeast Area Office
Kansas Department of Health and Environment - Bureau of Water: NPS Section
Kansas State University - Biological and Agricultural Engineering Department
Agronomy Department
Agricultural Economics Department
Animal Science and Industry Department
Nemaha/Marshall County Conservation District - Nonpoint Source Program
Kansas State Conservation Commission.

Other Issues

Several cost share programs were available to producers in the watershed. Generally, those involved with the program addressed only the environmental issues based on the current operation. Future expansion or other facility needs were not considered. The programs were also inflexible since only lagoons could be considered for handling lot runoff. Once a system was installed, guidelines for managing the system were not provided. Many dairies were seeking Kansas State University/Cooperative Extension Service (KSU/CES) assistance in addressing environmental issues and regulations. In addition, the field technician from Kansas Department of Health and Environment was willing to work with the dairies in the Black Vermillion watershed if they cooperated in making progress towards improving the environmental situation. Their assistance proved invaluable at the time in offering suggestions and helping the producers focus on the critical concerns.

Objective B: Task 3 and 5: Seasonal Effect on Manure Nutrients

Introduction

Environmental regulations generally focus on controlling and proper land application of manure nutrients. State permitting procedures require submission of a nutrient management plan. The nutrient plan usually includes an estimate of the manure nutrients applied to the land as well as crop nutrient utilization. Consulting engineers may work with the land owners and extension educators or crop consultants within a region and obtain reasonable nutrient utilization rates for the crops. However, obtaining data on manure nutrients actually applied to the land is not as readily available.

Many dairies are using total mixed rations and sand bedded freestalls. The difficulties in handling sand laden manure are offset by the benefits of cow comfort and higher milk quality. However, limited information is available on the nutrient content of sand laden manure. The purpose of this study was to characterize the nutrients in sand laden manure scraped from dairy facilities using total mixed rations.

Procedures

The study includes data from three sampling dates, February 5, April 8, and August 13 1999. Samples were collected from concrete manure storage basins at nine Kansas dairies. With one exception, all the dairies used sand bedding in the stalls. Each dairy scraped the freestall housing and feeding area and the milk parlor holding pen. The concrete basins were sized to provide 160 cu.ft. of storage per cow. The depth of the basin was 4 ft and the width and length was adjusted for each dairy site and size. Rainwater and effluent could drain from a basin through a perforated gate (4 ft by 12 ft) or a perforated pipe riser. The dairies fed a corn silage total mixed ration. These high producing herds ranged from 60 to 120 cows.

Liquid manure samples were retrieved using a capped PVC cylinder attached to a metal electrical conduit handle. A cord was connected to open the spring-closed lid while under the surface. Depending on the amount of manure in the basin, samples were taken at depths of 0.5 to 3 ft. The sampler was used to open the crust and was then pushed to the desired depth before the lid was pulled open to collect the sample. Four to six individual samples were taken from around the perimeter (3-4 ft from the edge) of each basin and then mixed in a bucket to make one composite sample. A plastic funnel was used to pour the sample into a one liter plastic bottle. The samples were refrigerated until sent for laboratory analysis. Total nutrient analysis was completed on each sample by Servi-Tech Laboratories.

Results

Table 5 shows the results of the samples taken from nine dairies during February, April, and August 1999, respectively. The data shows very little variability amongst the concrete basins tested even though the storage time and volume were different. Table 5 shows minimal difference of the average nutrient values between the sampling dates. The total nitrogen, P_2O_5 and K_2O averaged 10.1, 4.6 and 7.5 lbs per ton, respectively. The nitrogen to phosphorus (P_2O_5) utilization ratio of most crops is 2:1 to 4:1. Therefore, crops with a high N/P ratio would be required to have supplemental N sources to meet crop nutrient needs if phosphorus was a limiting nutrient. If one assumes most of the ash content is from the sand scraped into the basins, approximately 10-25 percent by weight of every load is sand. There was more variability of the ash content between the farms than any other nutrients. This is probably a reflection of the differences in the management of the cow housing areas and amount of sand used in the freestalls.

The moisture content of the solids applied to the land ranged from 66 to 83 percent with an average of 76 percent for the February samples. The manure spread from the concrete storage basin using gravity separation of the water may have a higher moisture content than mechanical separators using screens. The dry matter content was 24 percent.

The economic value of the nutrients is dependent on the current phosphorus levels of the cropland. The value of the manure placed on land with high phosphorus levels is only $3.00 per ton if only credit for the nitrogen and potassium is taken. Manure value increases to $4.00 per ton if credit for the

phosphorus is included. These values were based on nitrogen, phosphate and potash values of $0.20, 0.30 and 0.14 per lb. Crop land which is acidic may be able to utilize the manure as a lime replacement to increase the soil pH. Soil quality may be improved by the addition of the sand to improve moisture movement through the soil.

Conclusions

The following are conclusions obtained from the data:

1. The total nitrogen to phosphorus (P_2O_5) ratio was approximately 2:1 for total mixed rations using a corn silage based ration.
2. Approximately 10 to 25 percent of the manure applied to the land by weight was sand based on the ash content of the samples.
3. In the concrete solid storage basins, the moisture content of the manure averaged 75 percent during the winter and spring months.
4. The economic value of the nutrients in the manure was $3 to $4 per ton depending upon the current phosphorus levels in the cropland.

Objective 2, Task 2: Soil Profile Nutrient Accumulation in Fields Receiving Dairy Manure

Introduction

Nutrients are recycled to the land during manure application. Best Management Practice (BMP's) require laboratory analysis of the manure nutrients and soil sampling. Many producers utilize results from soil sampling and analysis to determine application rates for commercial fertilizers. Manure may be applied to the land after application of fertilizers without consideration of the potential to accumulate nutrients in the soil profile. Kansas regulates the quantities and amounts of swine manure that may be applied to fields. The application rates are based on yearly soil tests. The objective of this phase of the project was to determine the nutrient content in soil profiles that receive dairy manure and to determine the impact of the swine regulations applied to the dairy industry.

Study Procedures

Eleven fields from seven dairies in northeast Kansas were selected for this study. The fields receiving manure in northeast Kansas were predominately clay soils. Soil samples were taken randomly throughout the fields. At least ten soil samples were taken from each field. Samples from each field were thoroughly mixed with a composite sample sent to the Kansas State University (KSU) Soils Lab. Soil cores were taken at 0 to 6 in and 6 to 24 in. Samples were analyzed for phosphorus, potassium, ammonium and nitrate. The available nitrogen per acre was estimated using an agronomic equation.

Results

Figure 2 shows the soil phosphorus (P) levels at 0 to 6 in and 6 to 24 in depths from fields located in northeast Kansas. The P levels ranged from 15 to 345 ppm in the top 6 in. Fields 2W and 4E exceeded 150 ppm in the top 6 in. Using the swine regulations, no manure could be applied to these fields since the P level exceeds 100 ppm. Fields 4W and 9W could have manure applied based on the crop P utilization rather than nitrogen. Manure applications to 7 of the 11 (64%) fields could still be based on crop nitrogen usage. Soil P levels from 6 to 24 in ranged from 0 to 31 ppm. Again, fields 2W and 4E had the highest P concentrations at 31 and 20 ppm respectively.

The potassium (K) levels ranged from 197 to 475 ppm, except field 2W, for the top 6 in (Figure 3). At soil depths of 6 to 24 in, the K levels ranged from 142 to 347 ppm, except 4E. With the exception of the two fields, decreases in K from 0 to 6 in and soil depths of 6 to 24 in appeared fairly consistent.

Figures 4 and 5 show the ammonium and nitrate concentrations in the soil profile. The ammonium levels from 0 to 6 in varied from 3.5-8.5 ppm. and reduced to 1.4 to 3.6 ppm at soil depths of 6 to 24 in (Figure 4). Nitrate levels in five fields ranged from 5-10.2 ppm in the top 6 in. The remaining fields had nitrate levels ranging 22.5 to 76 ppm. The 6 to 24 in samples showed a similar pattern. The 5 fields with lower levels in the upper profile have nitrate levels of from 0.6 to 5.9 ppm in the deeper profile. The other six samples varied from 11.5 to 24.1 ppm. Figure 6 shows an estimate of the nitrate available on a per field basis in northeast Kansas. Nitrate levels in the soil profile from 0 to 24 in exceeded 150 lbs/ac on 5 of the 11 fields.

Conclusions

Field sampling shows phosphorus has accumulated to levels above 50 ppm in about 35 percent fields receiving dairy manure. About 20 percent of the fields would not be able to have dairy manure applied if the current Kansas swine manure application regulations were adopted. The development of BMP's for fields with high phosphorus content is critical to reduce the nutrient loading and long term utilization of the field for manure applications.

DEC-Part 1 Summary

The DEC-Part 1 was able to provide assistance to small dairy producers managing 1,680 lactating cows. These producers voluntary worked with the program in addressing environmental issues. The cost share dollars provided the necessary incentive for the producers to address environmental regulations.

Lesson Learned:

If phosphorus regulations were implemented, approximately 80 percent of the crop land receiving dairy manure would be able to meet current manure application guidelines similar to those implemented for the Kansas swine industry.

Dairies feeding similar feed rations will have similar nutrient contents in the solid manure basins. In addition, nutrient contents within the basin was similar throughout the year. This would enable more broad based nutrient management plans to be developed versus individual plans for each farm.

The nitrogen to phosphate ratio was approximately 2.5 to 1, nutrient management plans developed on a nitrogen bases would not result in excessive phosphorus being applied to the land assuming supplemental phosphorus was not being applied when using commercial fertilzers.

Approximately 10 to 25 percent of the manure applied to the land by weight was sand based on the ash content of the samples taken from dairies bedding free stalls with sand..

In the concrete solid storage basins, the moisture content of the manure averaged 75 percent during the winter and spring months.

The economic value of the nutrients in the manure was $3 to $4 per ton depending upon the current phosphorus levels in the crop land.

Remaining Work to be Completed

At the completion of the DEC-Part 1 project, there were 12 dairies still seeking assistance. A comparison between milk inspector permits and environmental permits indicates there are under 600 dairies but over 1,000 environmental permits issued. Some dairies may have multiple permits or sites have changed ownership with the original owner still on record as having a permit. Therefore, it is difficult to access the number of dairies that are not permitted. With the expansion of dairies in southwest, Kansas, it is estimated 70 to 80 percent of the cows in Kansas are being housed on facilities that are permitted. Dairies participating in the Black Vermillion and Dairy Environmental Cooperative program are still have trouble with the record keeping of volumes of manure applied along with location. This appears to be a continual problem even with the larger dairies during site visits and discussions. Efforts are needed to develop a producer friendly record keeping system. Manure nutrient management remains a critical issue, in particular, ensuring the commercial fertilizer applicators are making adequate allowances for manure nutrients.

Plans and Actions Intended by KSU

Increase efforts on the manure nutrient management including record keeping along with application.

Summarize the data on manure nutrients in solid storage basins and lagoons on dairies flushing versus scraping and it's potential impact on nutrient management planning.

Develop a series on web based publications on manure nutrient management and options for handling manure on dairies and focus on the educational delivery of the information obtained for the DEC-Part 1 program.

Continue to work with dairies in evaluating their options for addressing environmental issues. Along with assisting other agencies in helping small dairies seeking to implement control strategies.

Table 1. Summary of producer actions in the Black Vermillion Watershed after 2nd year of cost share program..

Summary of producer actions	Number	Percent	Cows*
Number of dairies in watershed	37		2750
Dairies permitted in 1997	8	22	
Disappearance of dairies due to sells, retirement, or environmental issues	9	24	
Dairies permitted through 1st year of DEC grant	8	22	
Dairies permitted through 2nd year of DEC grant	3	8	
Dairies express little or no interest	7	19	
Dairies permitted but received help to expand	2	5	
Number of dairies in 2002	28		2,750

Table 2. Action taken by the dairies cooperating in the Dairy Environmental Cooperative project.

Dairy ID	Control Structures Installed to Address Environmental Concerns			
	Milk Parlor*	Solids Storage Basin 100-120 days storage	Loafing Area Control Method	
			Lagoon	Vegetative Systems**
1	installed		installed	
2	installed		installed	installed
3	existing	expanded	existing	
4	existing	expanded	existing	
5	existing	installed		installed
6	installed	installed	installed	
7	existing	expanded	existing	
8	expanded	existing	installed	
9	installed	installed	installed	
10		installed		installed
11	installed	installed	installed	
12	existing	installed		
13	existing	installed	installed	

* Milk parlor wash water was controlled on each dairy using a lagoon.

** Dairies 5 and 10 were allowed to use terraces and grass buffers areas for the vegetative systems to reduce nutrient loads from the loafing areas. Dairy 2 used series of vegetative buffers and wetland cells.

Table 3. Summary of dairy size and nutrient loads from the dairies cooperating in the first year of the Black Vermillion project

Dairy	Watershed	HUC 11 Code	Cow No.	Animal	Percent	Additional	BOD	Nitrogen	Phosphate
			head	Units	Control	A.U.	lb/dy	lb/dy	lb/dy
1	Nemaha	10240007010	100	140	0	140	280	70	17
2	Mardia Cynes	10290101060	200	280	10	504	126	30	20
3	Nemaha	10240007010	300	420	75	105	210	53	13
4	Marion	11070262010	120	168	10	151	302	76	18
5	Nemaha	10240007010	150	210	75	532	105	26	6
6	Black Vermillion	10270205050	60	84	0	84	168	42	10
7	Black Vermillion	10270205050	160	224	0	224	448	112	27
8	Nemaha	10240007010	120	168	20	134	269	67	16
9	Nemaha	10240007010	150	210	0	210	420	105	25
10	Nemaha	10240007010	60	84	0	84	168	42	10
11	Nemaha	10240007010	80	112	0	112	224	56	13
12	Black Vermillion	10270205050	60	84	0	84	168	42	10
13	Nemaha	10240007010	120	168	20	134	269	67	16
	Total for 2nd year		1,680	2,353		1,768	3,535	884	212
	Total from 1st year		670	938		851	1,702	426	102
	Project Totals		2,350	3,291		2,619	5,237	1,310	314
	Goals		1,000	1400		1,400	2800	700	168
	Percent of 3 year Project Goals		235%	235%		187%	17%	187%	187%
	Totals in lbs/year						1,911,505	478,150	114,610
	Black Vermillion Watershed		950	1,330		1,243	2,486	622	149
	% of Goals obtained in Year 1		95%	95%		89%	89%	89%	89%

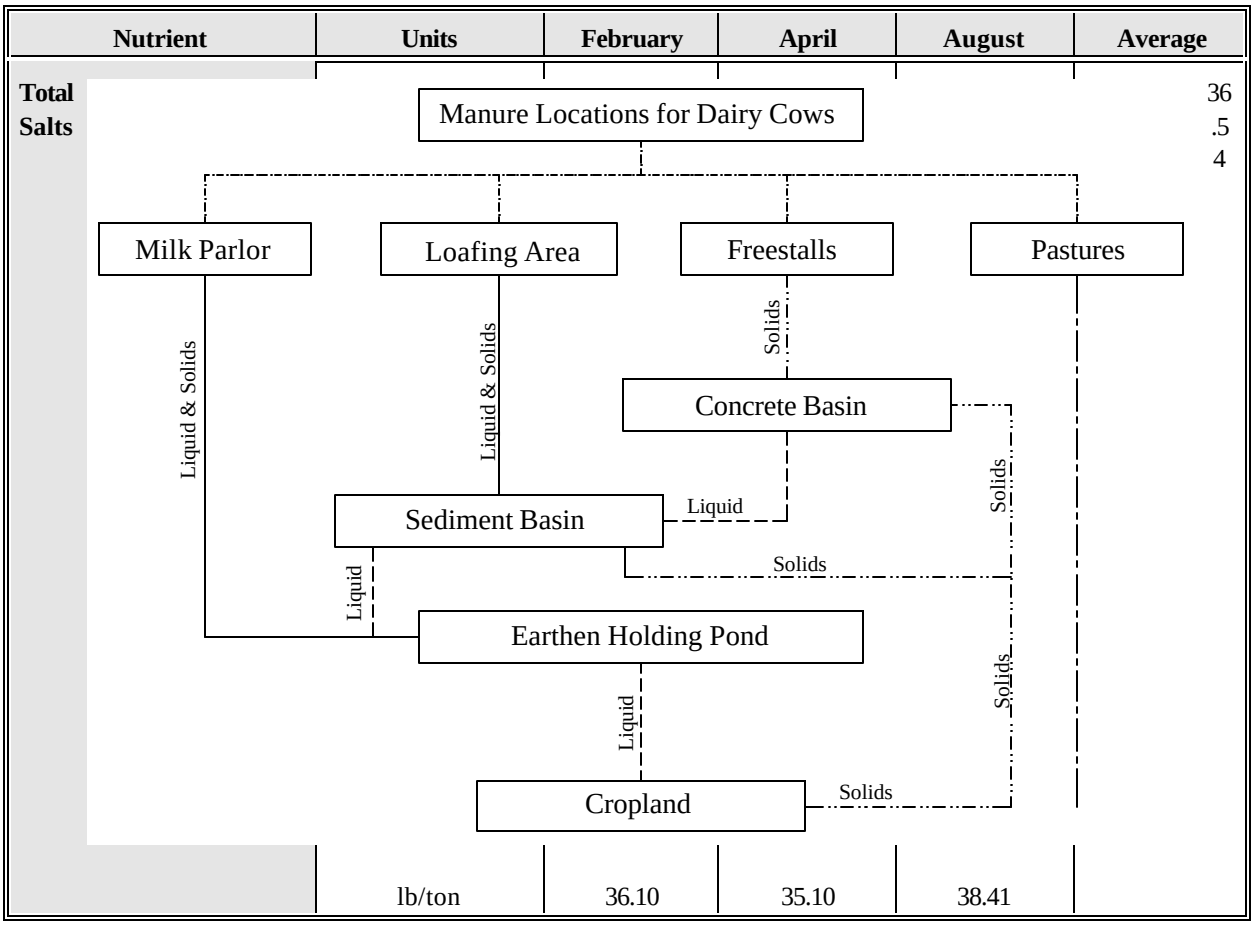
Table 4. Summary of expenditures for dairies addressing environmental expenditures and projected cost on a per cow or per animal unit bases.

Dairy	Watershed	HUC 11 Code	Cow No.	Animal	Cost	Cost Share		Total Project	Total Project	
			head	Units	Share	$ / cow	$ / A.U.	Cost ($)**	$ /cow	$/A.U.
1	Nemaha	10240007010	100	140	1,000	10	7	18,000	180	129
2	Mardia Cynes	10290101060	200	280	2,500	13	9	45,000	225	161
3	Nemaha	10240007010	300	420	5,000	17	12	24,000	80	57
4	Marion	11070262010	120	168	2,200	18	13	28,000	233	167
5	Nemaha	10240007010	150	210	6,000	40	29	17,000	113	81
6	Black Vermillion	10270205050	60	84	3,500	58	42	26,000	433	310
7	Black Vermillion	10270205050	160	224	10,000	63	45	20,000	125	89
8	Nemaha	10240007010	120	168	12,300	103	73	30,000	250	179
9	Nemaha	10240007010	150	210	21,000	140	100	32,000	213	152
10	Nemaha	10240007010	60	84	11,000	183	131	17,000	283	202
11	Nemaha	10240007010	80	112	3,000	38	27	34,000	425	304
12	Black Vermillion	10270205050	60	84	17,500	292	208	21,000	350	250
13	Nemaha	10240007010	120	168	3,250	27	19	35,000	292	208
	Total		1,680	2,352	98,250	$58	$42	347,000		
	Averages		1,680	2,352	15,071	77	55	26,692	246	176

* Some of the total project cost do not include labor provided by the farms but include the cost share money from of programs. Also, some of the dairies already had a lagoon in place to address milk parlor discharges.

Table 5. Impact of seasonal variability on manure nutrients in concrete storage basins

Nutrient	Units	February	April	August	Average
Organic Nitrogen	lb/ton	6.88	6.89	5.70	6.49
Urea	lb/ton	3.26	2.29	2.47	2.67
Nitrate-Nitrogen	lb/ton	0.01	0.01	0.01	0.01
Total Nitrogen	lb/ton	10.14	9.19	7.36	8.89
Phosphorus P_2O_5	lb/ton	4.62	4.49	5.45	4.85
Potassium K_2O	lb/ton	7.54	7.25	7.54	7.44
Calcium	lb/ton	8.04	7.80	8.72	8.19
Magnesium	lb/ton	3.14	3.13	3.81	3.36
Sulfur	lb/ton	1.27	1.23	1.36	1.29
Sodium	lb/ton	1.82	1.82	1.90	1.85
Zinc	lb/ton	0.05	0.05	0.06	0.05
Iron	lb/ton	1.40	1.48	1.65	1.51
Manganese	lb/ton	0.08	0.09	0.10	0.09
Copper	lb/ton	0.01	0.02	0.02	0.01
Boron	lb/ton	0.01	0.01	0.01	0.01
Other Properties:					
Moisture	%	76.0	73.8	76.3	75.4
Solids	%	24.0	26.2	23.7	24.6
Organic Matter	lb/ton	195.74	198.52	197.59	197.3
Ash	lb/ton	284.93	324.74	275.70	295.1
C/N Ratio		11	12	14	12
EC	mmho/cm	10.4	6.2	33.6	16.7
pH		7.3	6.9	6.8	7.0


Nutrient
Units
February
April
August
Average
Total Salts
36.5.4
Manure Locations for Dairy Cows
Milk Parlor
Loafing Area
Freestalls
Pastures
Liquid & Solids
Liquid & Solids
Solids
Concrete Basin
Solids
Liquid
Sediment Basin
Solids
Liquid
Earthen Holding Pond
Solids
Liquid
Cropland
Solids
lb/ton
36.10
35.10
38.41

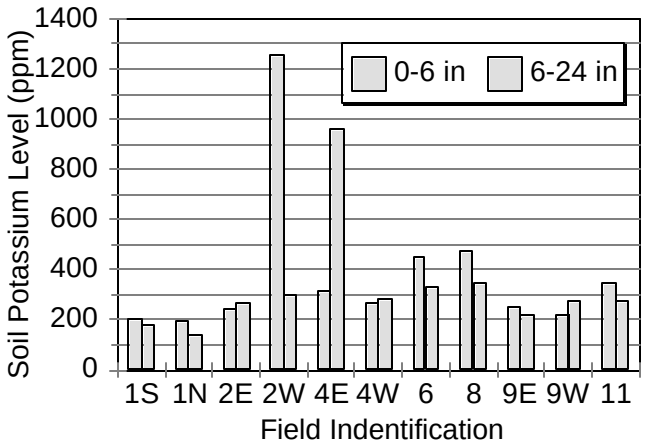


Figure 1. Flow diagram of environmental audit of a dairy based on location where manure is generated.

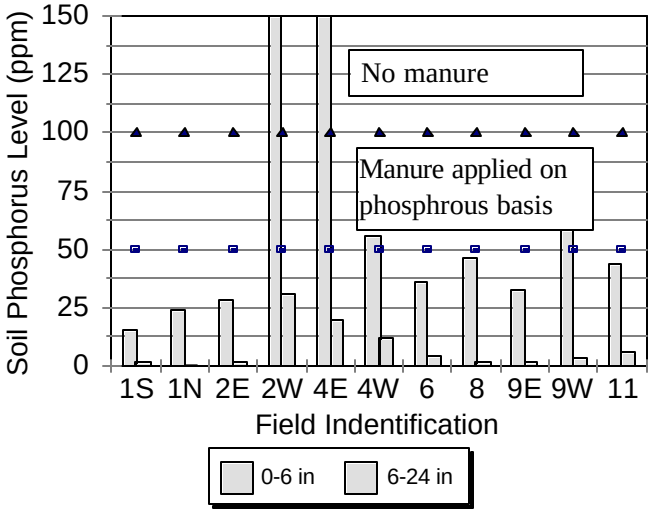


Figure 2 Soil phosphorus levels from fields in northeast Kansas receiving dairy manure.

Figure 3. Soil potassium levels from fields in northeast Kansas receiving dairy manure.

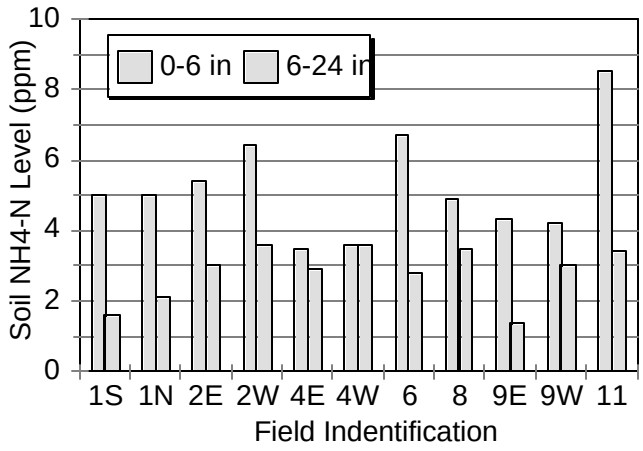


Figure 4. Soil ammonium levels from fields in northeast Kansas receiving dairy manure.

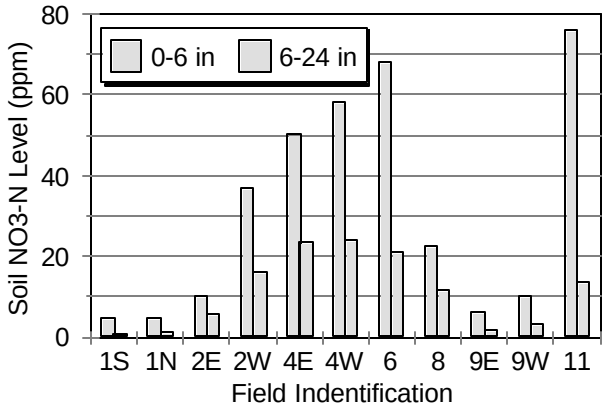


Figure 5. Soil nitrate levels from fields in northeast Kansas receiving dairy manure.

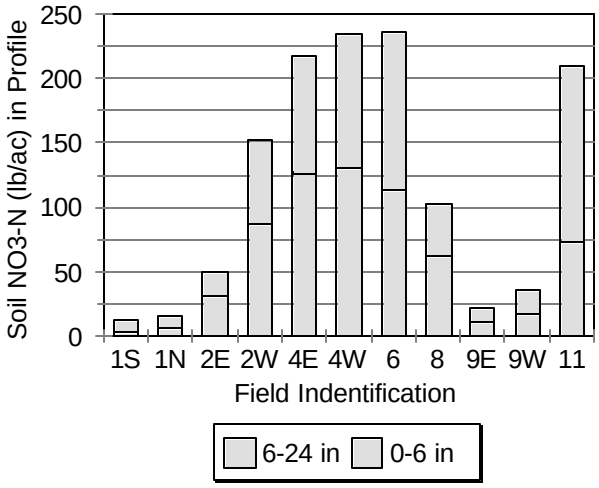


Figure 6. Soil nitrate (lbs/ac) available for crop utilization from fields receiving dairy manure in northeast, Kansas.